

# JOINT TECHNOLOGY EXCHANGE GROUP AIR FORCE ENVIRONMENTAL INITIATIVES



Pollution Prevention R&D Project Office

AFRL/MLQL

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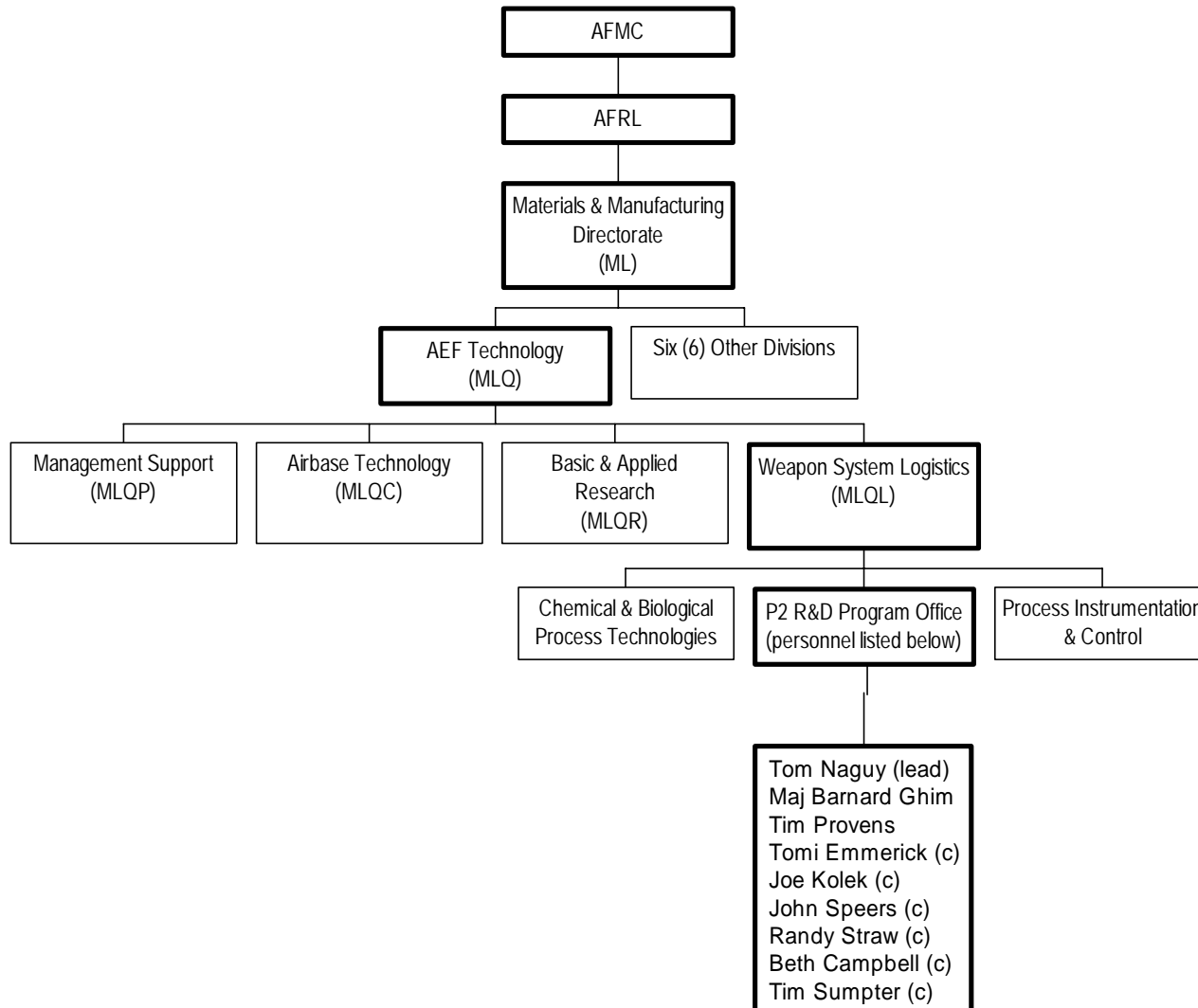


# OUTLINE

- AFRL Organization
- Mission
- Focus
- Main Customers/Interfaces
- Selected Projects
- Wrap-up



# ORGANIZATION





# MISSION

## Motivation

- Requirements on materials and processes threaten sustainment and modernization of systems.
- Lack of available technology and materials to replace costly and restricted materials.

## Goal

- Develop environmentally acceptable technology that reduces costs and threats to AF mission and modernization.

## Strategy

- Concentrate on highest priority needs as identified by Air Force organizations.
- Identify available technology.
- Deliver timely products to satisfy broad range of users.

## Payoff

- Decreased mission impacts due to program delays and cost overruns.
- Streamline high priority Pollution Prevention R&D by eliminating duplicative efforts and leveraging funds.
- Technology solutions are provided to numerous AF customers.



# STRATEGIC FOCUS

- Avoiding “nice R&D”
  - limited hardcore 6.2
- Affordable technologies
  - e.g. handheld laser
    - multi-configurations
    - high volume throughput
- User coordination/involvement
- Requirements driven
- Compliance through  $P^2$  (CT  $P^2$ )
  - near term results



# MAIN

## CUSTOMERS/INTERFACES

- ESOH TPIPT P<sup>2</sup> Needs Submitters
  - Primarily ALCs and MAJCOMs
- HQ AFMC Requirements Development Team
- HQ AFMC P<sup>2</sup> IPT
- Propulsion Environment Working Group (PEWG)
- Strategic Environmental Research and Development Program (SERDP)
- Environmental Security Technology Certification Program (ESTCP)



# SELECTED PROJECTS

- Environmentally Advantaged RAM Coatings (EARC)
- Handheld Laser Cleaner/Coatings Remover
- Cadmium Alternatives
- Non-Chrome Aluminum Pretreatments
- Non-line of Sight (NLOS) Hard Chrome Alternatives
- Non Destructive Inspection (NDI) Through HVOF Coatings
- Oxidizer Vapor Recovery System
- Alternative Cleaners for Aerospace Systems



# ENVIRONMENTALLY ADVANTAGED RAM COATINGS (EARC)

## Challenges

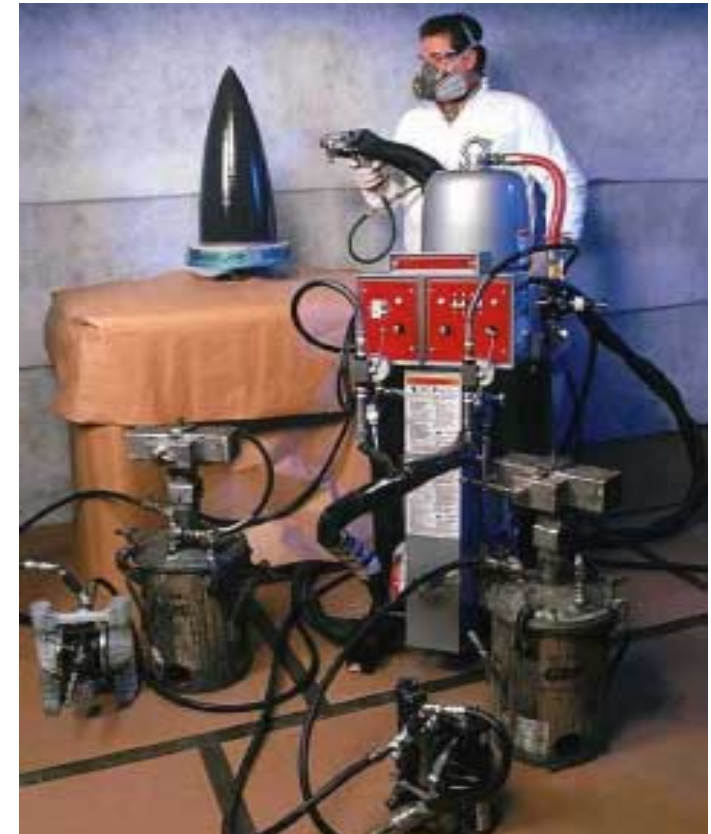
- RAM coatings contain 2-3x VOC/HAP vs. conventional coatings

## Goal

- Reduce
  - VOCs/HAPs up to 60%
  - Flow time up to 75%
  - Worker exposure

## Approach

- Leverage Boeing work
- Plural spray technology
- Evaluate resins, fillers, equipment
- Eight candidates —————→ one
- Optimize
- Demonstrate at Depot or OEM







# HANDHELD LASER CLEANER/ COATINGS REMOVER

## Challenges

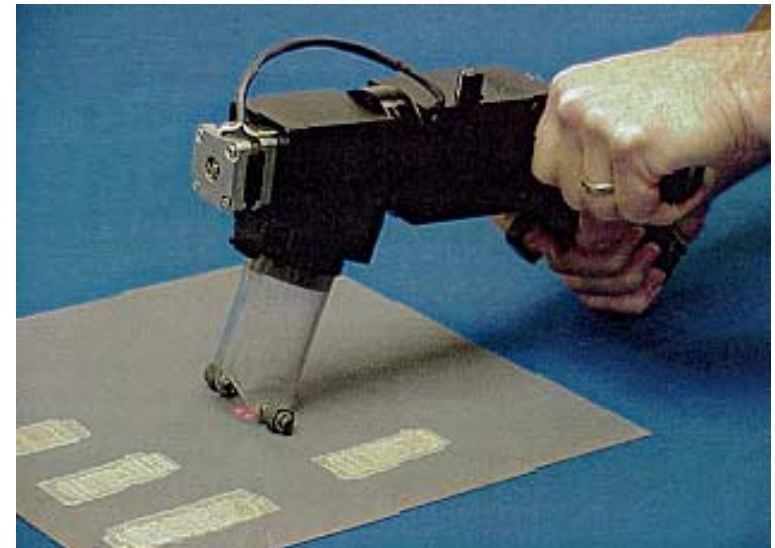
- Hazardous chemicals used in paint removal and organic contaminant cleaning
  - HAZMATs and EPA/AF lists

## Goal

- Reduce/eliminate hazardous waste
- Reduce worker exposure
- Reduce flow time

## Approach

- Supplement existing paint removal technology, spot cleaning, and surface preparation for adhesive bonding - two programs
- Refine handheld laser design using existing portable head and fiber optics
- JTP Development & Testing
- Refine requirements, demonstrate, and validate process





# CADMIUM ALTERNATIVES

## Challenge

- Cadmium is a HAZMAT/wastestream

## Goal

- Eliminate/reduce use of Cd/eliminate wastestream/reduce environmental costs
- Reduce worker exposure
- Focus on complex shapes and Non-line of Sight areas

## Approach

- Joint effort w/NAWC, Pax River/JG-PP/ESTCP
  - Evaluate, characterize, optimize alternatives to Cd
    - Steels, fasteners, electrical connectors
  - Screen emerging technologies - Develop PAR
  - Dem/Val on A/C components transition best alternatives
  - AFRL/ML mechanical tests/manage AF specific program





# NON-CHROME ALUMINUM PRETREATMENTS

## Challenge

- Chromium is HAZMAT/wastestream

## Goal

- Eliminate/reduce use of chromium/eliminate wastestream/reduce environmental costs
- Reduce worker exposure
- Focus on conversion coatings as a coatings system for conversion coatings sprayed on A/C

## Approach

- Joint effort w/NAWC, Pax River/JG-PP/ESTCP
  - Evaluate, characterize, optimize alternatives
  - Support developing of JTP
  - Dem/Val on A/C components at user facilities/transition best alternatives
  - AFRL/ML mechanical/manage AF-specific program



X-IT Prekote Alodine 1200S



# NON-LINE OF SIGHT (NLOS) HARD CHROME ALTERNATIVES

## Challenges

- HVOF coatings are DoD's primary alternative to chrome plating on critical high strength steel components
  - But Line-of-Sight Process:
    - 60-80% current chrome plated parts
  - Project focuses on remaining 20-40% parts (NLOS/complex applications)

## Goal

- "Drop-In" replacement Development/Implementation
- Reduce Hazardous Pollutants/Hazardous Wastes
- Reduce workers' health & safety risks



# NON-LINE OF SIGHT (NLOS) HARD CHROME ALTERNATIVES (cont'd.)

## Approach

- Develop alternative for Electroless Hard Chrome (EHC) plating for depots
- Analyze requirements
- ID components, processes, materials
- Demo, validate, optimize process
- Implement, train at depots
  - i.e. transition!





# NON-DESTRUCTIVE INSPECTION (NDI) THROUGH HVOF COATINGS

## Challenges

- HVOF coatings replacing EHC on critical high strength steel components
- Landing gear inspected by visual and NDI techniques to determine substrate cracks
- Ability to detect substrate cracks under chrome plating well established
- • But ability to detect substrate cracks under HVOF coatings with the same level of confidence not demonstrated



# NON-DESTRUCTIVE INSPECTION (NDI) THROUGH HVOF COATINGS (cont'd.)

## Goal

- Assess HVOF coating's compatibility for NDI inspection employing different NDI techniques to detect substrate cracks compared to the NDI inspection of uncoated specimen

## Approach

- AFRL/ML managing assessment program
  - Specimen definition & coatings
  - Initiate and grow cracks in high strength steel specimen that have been HVOF coated with Tungsten Carbide-Cobalt (WC-17 Co) and with EHC
  - Flaw initiation, crack growth, and NDI assessment
  - Report and feedback to community





# OXIDIZER VAPOR RECOVERY SYSTEM (SPACE & MISSILE SYSTEMS)

## Challenge

- Hypergolic fuel vapors major wastestream
  - Single largest wastestream at Cape Canaveral AFS, KSC, Vandenberg AFB

## Goal

- Eliminate 300,000 lbs. hazardous wastes per year and ~ \$72,000 in disposal costs

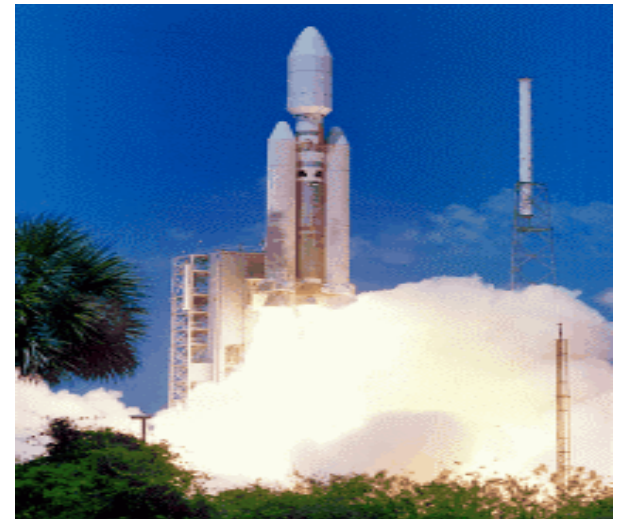




# OXIDIZER VAPOR RECOVERY SYSTEM (SPACE & MISSILE SYSTEMS) (cont'd.)

## Approach

- Build on previous R&D funded by AF Space & Missile Center and NASA
- Evaluate three leading candidate technologies to process hypergolic fuel vapors
  - Design, fabricate, and performance test pilot scale microwave reactor system
  - Evaluate sodium hydroxide/hydrogen peroxide vapor scrubber
  - Evaluate condensation by low temperatures





# ALTERNATIVE CLEANERS FOR AEROSPACE SYSTEMS

## Challenge

- Many cleaners employed in aerospace systems are high in ozone depleting compounds (ODCs) and health hazard

## Goal

- Eliminate use of ODCs in USAF aerospace precision cleaning operations
- Eliminate need for ODC use waiver



# ALTERNATIVE CLEANERS FOR AEROSPACE SYSTEMS (cont'd.)

## Approach

- Identify and quantify current uses of Freon 113 and trichloroethane in USAF aerospace precision cleaning operations
- Determine performance criteria for alternatives
- Identify and screen potential alternatives
- Dem/Val selected environmentally advantaged alternatives





# WRAP-UP

- Good understanding of AF needs
- User coordination
- Solid interface with environmental community
- Timely solutions/minimal costs
- Affordability is a key
- Number of near-term payoff programs in work or in planning